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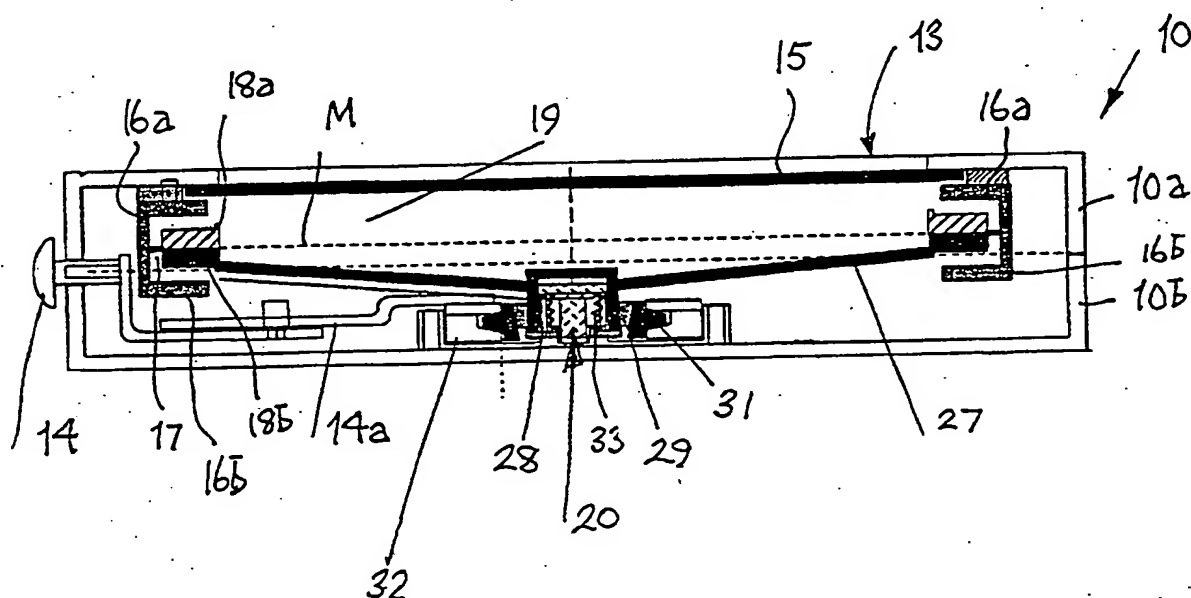
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(54) Title: IMPROVED ADJUSTABLE MIRROR

**(57) Abstract**

A flexible membrane mirror comprises a housing (10) containing a closed space (19) delimited in part by a tensioned reflective flexible membrane (M) and means (14, 14a, 32, 31, 30, 18b) to vary the pressure in the closed space (19) to alter the radius of curvature of the membrane (M) and thus to vary the power of the mirror. The means to vary the pressure in the space (19) delimited by the reflective membrane (M) includes clutch means (29, 31) in the pressure varying means.

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IMPROVED ADJUSTABLE MIRRORTechnical Field

This invention relates to a flexible membrane mirror comprising a housing containing a closed space delimited in part by a tensioned reflective flexible membrane and means to vary the pressure in the closed space and thereby alter the radius of curvature of the membrane to vary the power of the mirror.

Part spherical mirrors based upon a reflective flexible member whose radius of curvature can be adjusted in some way are well known. Some such mirrors use mechanical means to stress edge regions of a disc of flexible reflective material, means being provided to alter the forces applied to the edge regions to vary the shape of the mirror surface and thus vary the power of the mirror.

This invention, however, is concerned with that type of flexible membrane mirror which uses variations in the pressure of a medium contained in a closed space delimited in part by the membrane to provide the required changes in the shape of the membrane and thus in the power of the mirror.

Summary of the Invention

According to one aspect of the present invention the means to vary the pressure in the space delimited by the reflective membrane include clutch means in the pressure varying means.

Desirably the closed space is created by a pair of annular clamp rings supporting a tensioned disc of reflective air impermeable membrane material, a transparent front sheet (e.g. of glass - preferably non-reflectively coated) which is less flexible than the membrane material, and a perimeter member hermetically sealed to the front sheet and to the clamp rings, the perimeter member allowing displacement of the clamp rings relative to the front sheet to vary the volume of the

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closed space, the pressure varying means acting on the clamp rings and being connected to a mirror power-adjustment member via the said clutch means.

The arrangement described above in which a closed space  
5 is created between the transparent front sheet and a flexible reflective mirror membrane is a convenient solution to the problem of creating a mirror of variable power. However, one problem that needs to be addressed in a practical embodiment of such a mirror is that excessive reductions in ambient  
10 pressure (e.g. such as experienced when flying) will occasion a major increase in the volume of the closed space which can damage the flexible membrane if means are not provided to prevent such an occurrence. Surprisingly, we have found that by simply locating clutch means in the pressure varying means  
15 and arranging for this clutch means to release the membrane support from the normal mirror-power adjustment member, the membrane can accommodate sharp changes in ambient pressure without risk of damage to the membrane or the associated pressure varying means.

20 Suitably the mirror power-adjustment member is a cam movably mounted in a housing of the mirror and a cam follower connecting with a spider engaging the membrane clamp rings. The clutch means can be located between the cam follower and the spider. A rotary cam is one convenient arrangement and  
25 this can be linked by a motion-transmitting linkage to a knob slidably disposed in the mirror housing (e.g. in an edge region thereof).

The housing of the mirror can be provided with a base plate permitting the mirror to be supported at a convenient  
30 angle for use on a flat surface such as a table and it is convenient to arrange for the base plate to be mounted on the housing in a manner permitting it to be collapsed against the frame for storage and transport. Suitably a base plate, when so collapsed, overlies the front sheet and also engages the  
35 mirror-power adjustment member moving the latter to its

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position of lowest mirror power. Suitably the clutch means is declutched when the adjustment member is in its position of lowest mirror power.

Brief Description of Drawings

5 One embodiment of flexible membrane mirror in accordance with the invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a general view of the mirror in its erected condition ready for use,

10 Figure 2 is a view of the mirror collapsed for storage and transport,

Figure 3 is a section on the line III-III of Figure 1 showing the component parts of the mirror,

Figures 4 and 5 are views of respective front and rear  
15 parts of a case housing the flexible mirror,

Figures 6 and 6A are sectional and plan views of front and rear rings to assist in mounting the flexible membrane within the case, the front ring forming part of the perimeter of the closed space delimited by the front sheet and the  
20 flexible membrane,

Figures 7, 7A and 7B are views of a flexible annular bellows member for location between the front and rear mounting rings of Figures 6 and 6A,

Figure 8 is a view of one of a pair of membrane  
25 tensioning clamp rings across the aperture of which the flexible reflective mirror membrane is tensioned and Figure 8A is a scrap section thereof on an enlarged scale,

Figures 9, 9A and 9B are views of the other of the membrane clamp rings including a spider forming part of the

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pressure varying means of the mirror,

Figures 10 and 10A are views of the clutch member for engagement with the spider of Figure 9, and

Figures 11 and 11A are views of a lifting collar for coaction with the clutch member of Figure 10.

#### Description of Preferred Embodiments

Referring first to Figures 1 and 2 a portable mirror of adjustable power is housed within a case 10 provided with a base 11 which can be used as shown in Figure 1 to support the case 10 at a desirable angle relative to a flat surface on which the base 11 rests, the case being held at that angle by a pivoted stay 12 which engages with a recess (not shown) in the base.

The front part of the case 10 is provided with an aperture 13 through which a part-spherical mirror surface can be seen, the radius of curvature of this mirror surface being adjustable by means of a knob 14 which can be slid downwardly from the position shown in Figure 1 to increase the power of the mirror.

Figure 2 shows the mirror unit of Figure 1 folded up for safe transport, it being noted that the base 11 now overlies the front of the case 10 fully protecting the aperture 13 and, by virtue of engagement of ears 11a of the base 11 with the knob 14, ensuring that the latter is in its uppermost position, this corresponding to the lowest power of the flexible mirror (typically when the radius of curvature of the flexible membrane is infinite).

Figure 3 is a section through the case 10 on the line III-III of Figure 1 and shows the construction of the mirror mechanism within the case 10.

A front sheet 15 (e.g. of non-reflective glass) is sealed

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to the front housing part 10a across the aperture 13 and to a front mounting ring 16a. An annular bellows ring 17 is clamped between the front mounting ring 16a and a rear mounting ring 16b around its outer periphery and is clamped between membrane tensioning clamp rings 18a, 18b around its inner periphery.

The flexible membrane providing the mirror surface and completing the closed space 19 is shown dotted at M in Figure 3.

10 The volume of the closed space 19 can be varied by pressing the rear clamp ring 18b towards the front sheet 15 using the mechanism shown generally at 20 in Figure 3, the bellows ring 17 allowing movement of the clamp rings towards the front sheet 15 in the face of this increased pressure.

15 Figures 4 and 5 show the front 10a and rear 10b parts of the case 10, part 10a providing the aperture 13 and the two parts together providing a slot along one side of the case 10 along which the adjusting knob 14 can move. The knob 14 is also shown in Figure 3 as is the linkage 14a connecting it to  
20 an annular cam member 32 of a mechanism generally designated 20.

Figures 6 and 6A show one of the pair of front and rear mounting rings 16a, 16b which are required to provide the perimeter of the closed volume of dry gas (usually air) contained in the space 19 which is bounded on one side by the front glass 15 and on the rear side by the flexible membrane M. The two mounting rings 16a, 16b are identical, each being alternately provided around its perimeter at 60° intervals with a male member 21 and a female recess 22 (see the  
25 sectional view in Figure 6A). When the male members 21 of these rings are engaged in the female recesses 22 the outer perimeter 23 of the annular flexible bellows ring 17 shown in Figure 7 can be trapped therebetween.

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The inner annular member 24 of the ring 17 shown in Figure 7, 7A and 7B is trapped between the front clamp ring 18a of Figure 8 and the rear clamp ring 18b of Figure 9. Each of the rings 18a and 18b contains a recess 25 (see Figures 8A 5 and 9A) to receive an O-ring 26, the flexible reflective membrane mirror material M being squeezed between confronting O-rings 26 in the two clamp rings 18a and 18b. This method of uniformly tensioning a flexible membrane is described in EP-A-0291596.

10 The rear clamp ring 18b shown in Figure 9 has a spider 27 which terminates in a cup 28 the outer surface of which is accurately formed to provide part of a clutch surface engaged by the arms of a collet 29 shown in Figure 10. Three arcuate lugs 30 of the collet 29 have accurately formed cylindrical 15 surfaces on their inner faces which are designed to frictionally bind with the outer face of the cup 28 of the spider 27 whereas the outer surface of these lugs 30 are of frusto-conical form (see Figure 10A) to make firm engagement with a lifting collar 31 shown in Figure 11. Figure 3 shows 20 how the lifting collar, the collet and the cup in the centre of the spider are interlinked with the annular cam member 32 turned by the linkage 14a when the knob 14 is moved along its slot in the case 10.

By means of the linkage 14a, when the knob 14 is moved 25 downwardly in its slot in the side of the case 10 the collar 31 is lifted by means of the cam member 32 and a cam follower defined by the outer edge of the collar 31 causing the frusto-conical surface on the lifting collar 31 to bear against the frusto-conical surface on the lugs of the collet 29 thereby 30 forcing the cylindrical surfaces on the collet 29 and cup 28 into firm frictional engagement. Once this firm frictional engagement is established, further movement of the lifting collar 31 causes the clamp rings 18a, 18b to move towards the front sheet 15 of the closed space 19 increasing the pressure 35 of the air trapped therein and causing the flexible membrane M to bow with increasing radius of curvature as the lifting

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collar 31 continues to be raised (as shown in Figure 3) by movement of the knob 14.

Thus, in use of the mirror, the user can control the magnification viewed through the aperture 13 by adjusting 5 vertically the knob 14 and the set power of magnification will be retained for so long as the knob 14 is left in its adjusted position. However, when the knob 14 is returned to its uppermost position, not only is the collar 31 lowered to increase the separation between the front glass sheet 15 and 10 the clamp rings 18a, 18b of the flexible membrane M but also the drive between the cylindrical surface of the cup 28 and collet 29 is released so that the spider 27 and its clamp ring 18b can float in the face of a sudden reduction in ambient pressure such as might be experienced during an aeroplane 15 flight.

A compression spring 33 can be located in the cup 28 between the closed end thereof and the collet 29 to cause binding between the cup 28 and the collet 29 during adjustments of the power of the mirror. The clutch frees 20 itself when the knob 14 is in its lowest power position because the collet 29 is arranged to hit a dead stop formed on the rear housing part 10b of the case 10 just before the knob 14 reaches its uppermost position. In the final part of the movement of the knob 14 the collet 29 is driven further 25 down (e.g. by 0.5 mm) by the cam follower 32 so that the collet 29 no longer bears inside the collar 31.

From Figure 2 it will be seen that when the base plate 11 is put into its position overlying the aperture 13 in the case 10, the knob 14 is held in the position in which the 30 clutch member is so released.

It will be appreciated that many modifications are possible within the scope of the invention. Thus, for example, the flexible link between the frame supporting the mirror membrane need not be a bellows ring. The two parts

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16a, 16b need not be identical (or as shown) and the membrane M need not be tensioned between opposed O-rings as described.

The arrangement of a base 11 as a protection for the mirror in a closed condition of the device can be applied to 5 other mechanisms which might not need a clutch means.

A convex mirror may be created rather than a concave mirror as described here.

The closed space 19 can include desiccant material and a valve member can be provided (e.g. attached to ring 16b) to 10 permit filling of the space with gas.

Metallised MYLAR (RTM) makes an acceptable membrane but acrylic coated materials may have advantages. The rings 16a, 16b, 18a, 18b could be moulded from suitable plastics materials.

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CLAIMS

1. A flexible membrane mirror comprising a housing containing a closed space delimited in part by a tensioned reflective flexible membrane and means to vary the pressure 5 in the closed space to alter the radius of curvature of the membrane and thus to vary the power of the mirror, characterised in that the means to vary the pressure in the space delimited by the reflective membrane includes clutch means in the pressure varying means.

10 2. A mirror according to claim 1, in which the closed space is created by a pair of annular clamp rings supporting a tensioned disc of reflective air impermeable membrane material, a transparent front sheet which is less flexible than the membrane material, and a perimeter member 15 hermetically sealed to the front sheet and to the clamp rings, the perimeter member allowing displacement of the clamp rings relative to the front sheet to vary the volume of the closed space, characterised in that the pressure varying means act on the clamp rings and are connected to a mirror adjustment 20 member via said clutch means.

3. A mirror according to claim 2, characterised in that the mirror power-adjustment member is a cam movably mounted in a housing of the mirror and a cam follower connecting with a spider engaging the membrane clamp rings.

25 4. A mirror according to claim 3, characterised in that the clutch means can be located between the cam follower and the spider.

5. A mirror according to claim 4, characterised in that the mirror power-adjustment member is a rotary cam linked by 30 a motion-transmitting linkage to a knob slidably disposed in the mirror housing.

6. A mirror according to any preceding claim,

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characterised in that the housing of the mirror is provided with a base plate permitting the mirror to be supported at a convenient angle for use on a flat surface such as a table.

7. A mirror according to claim 6, characterised in that  
5 the base plate is mounted on the housing in a manner permitting it to be collapsed against the frame for storage and transport.

8. A mirror according to claim 7, characterised in that  
the base plate, when collapsed overlies the front sheet and  
10 also engages the mirror-power adjustment member holding the latter to its position of lowest mirror power.

9. A mirror according to any preceding claim,  
characterised in that the clutch means is declutched when the  
adjustment member is in its position of lowest mirror power.

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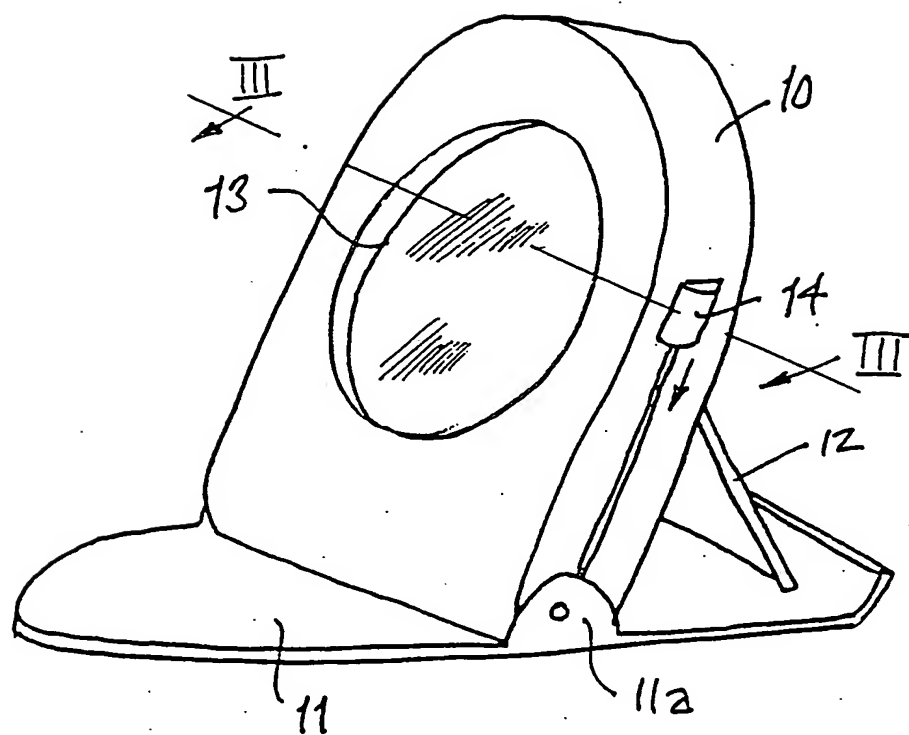


FIG. 1

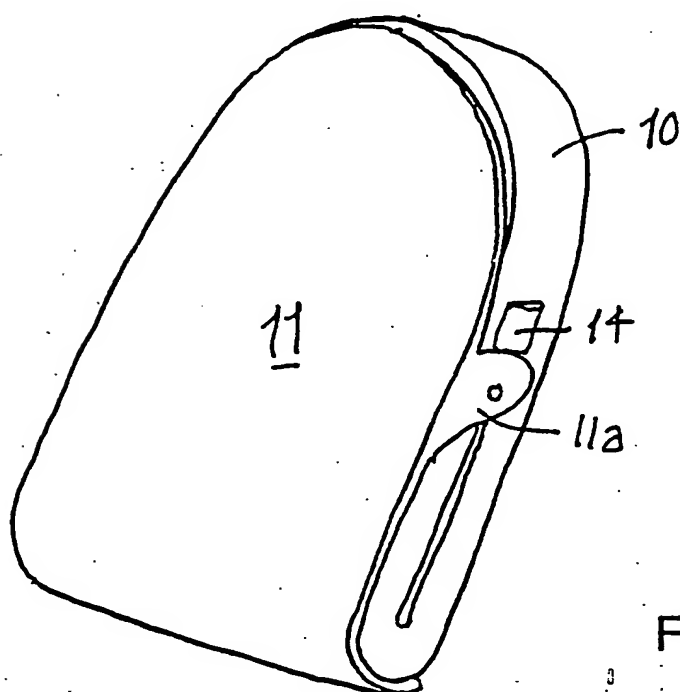


FIG. 2

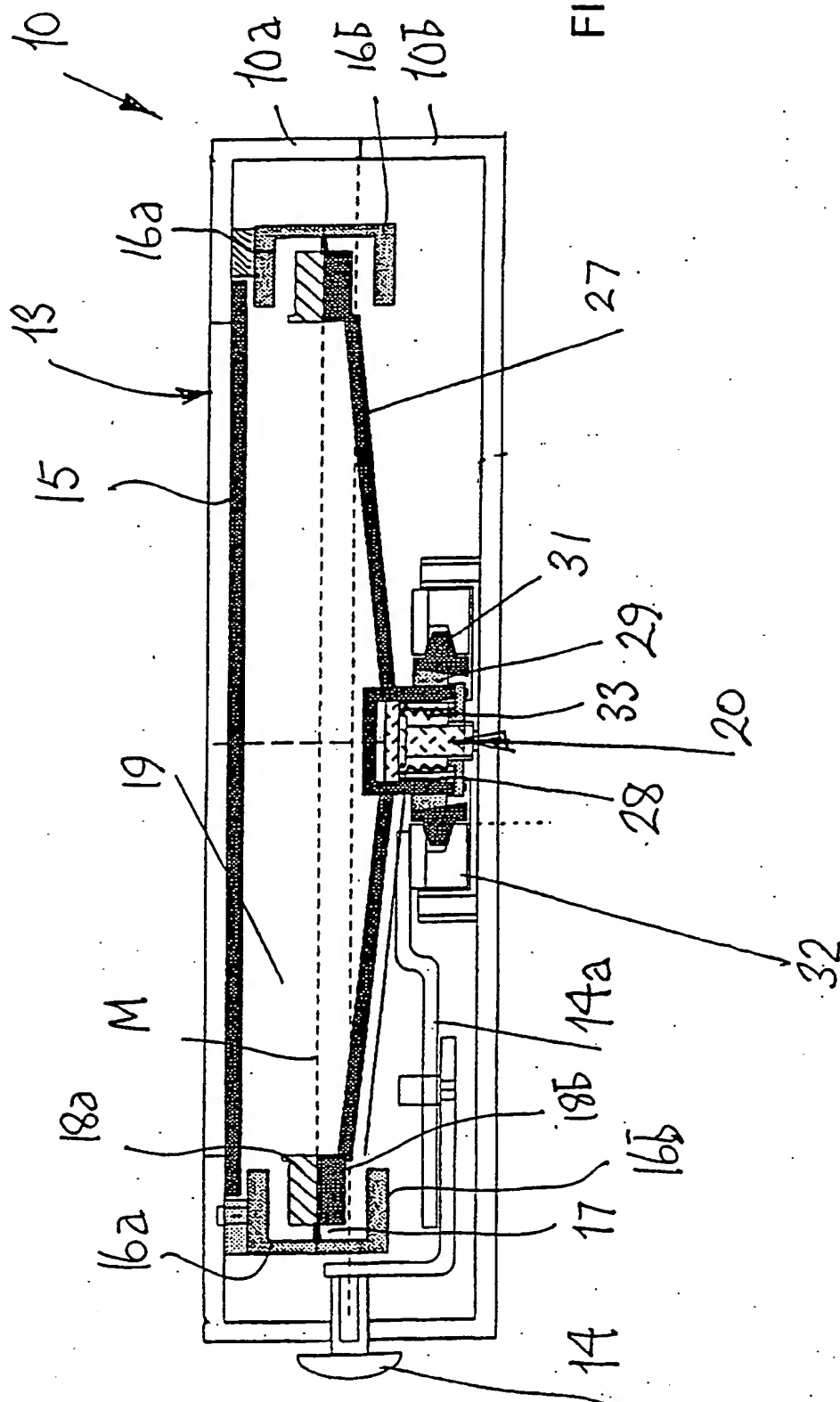


FIG. 3

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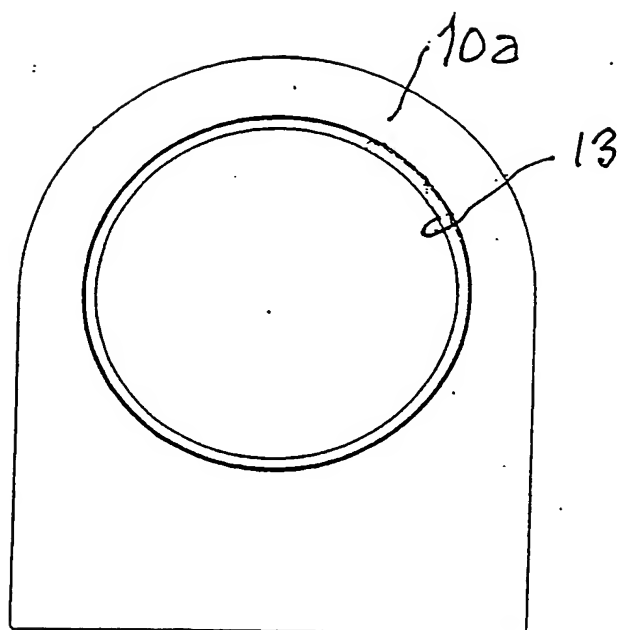


FIG. 4

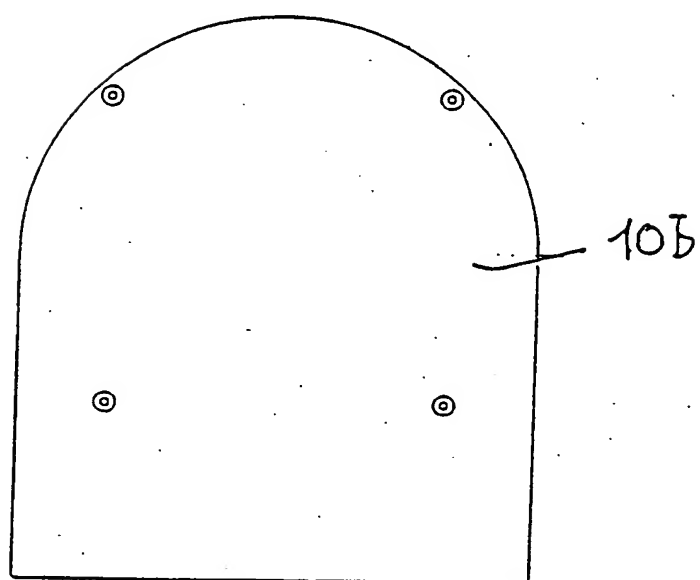


FIG. 5

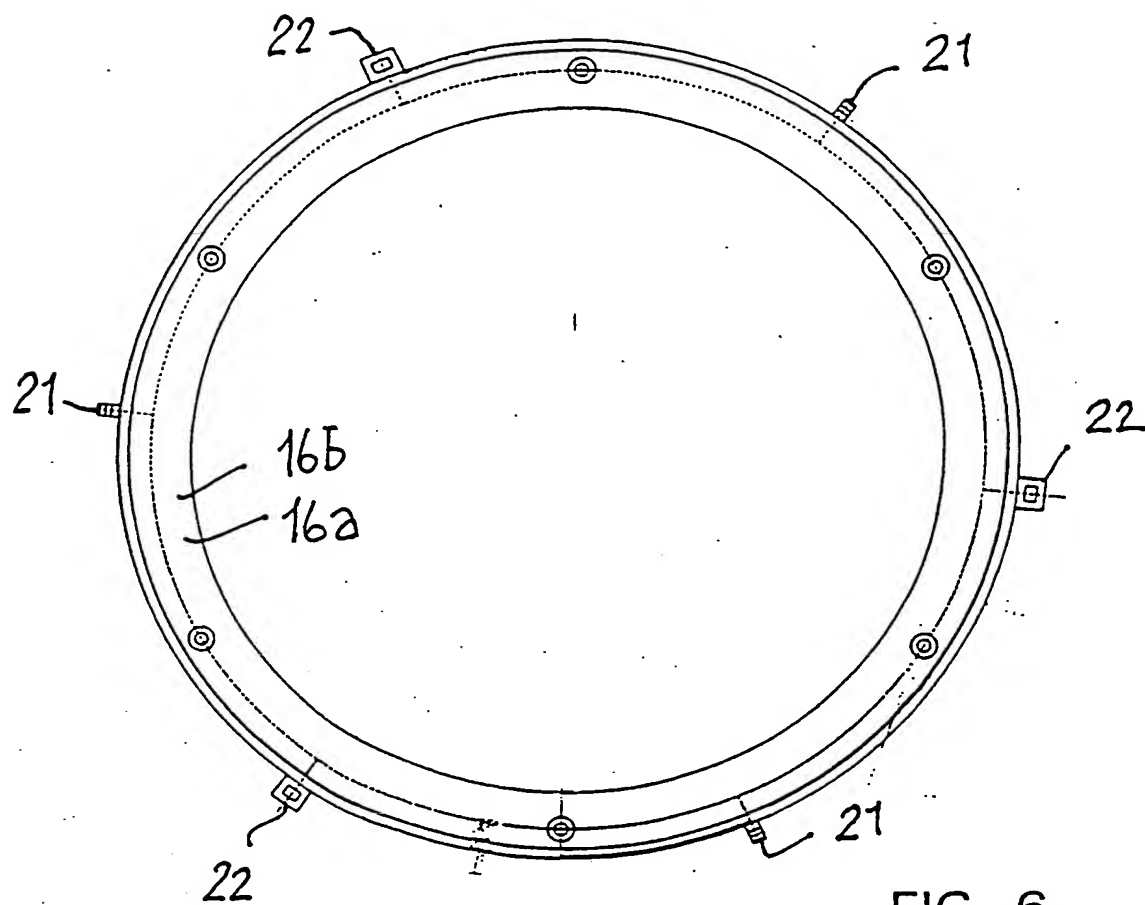


FIG. 6

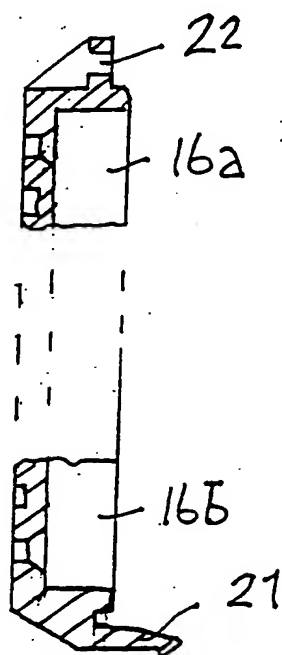
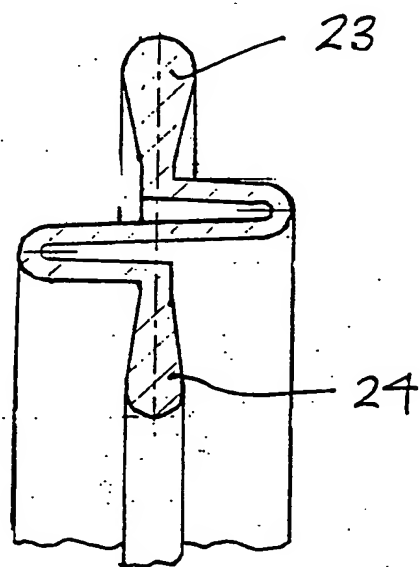
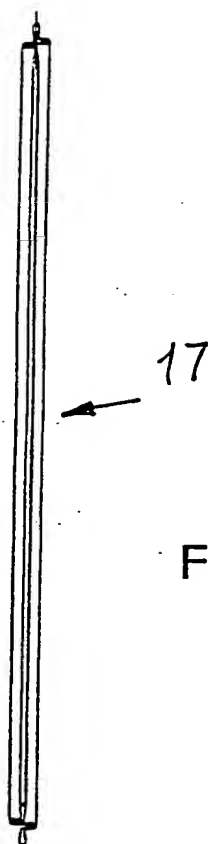
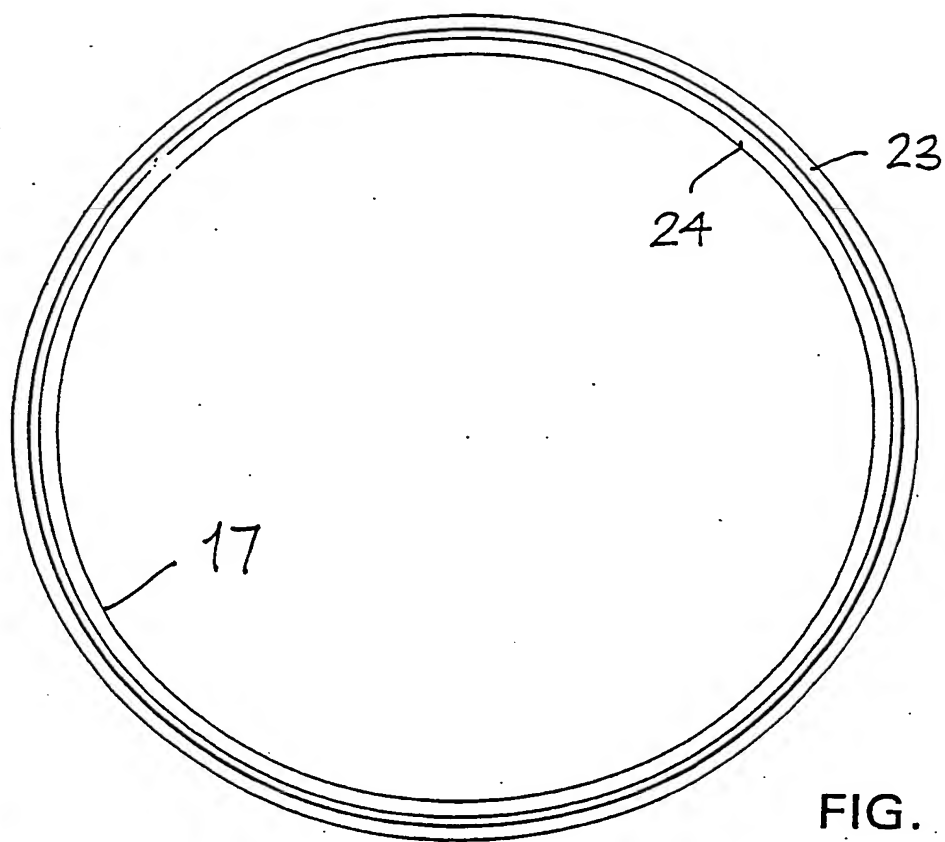


FIG. 6A



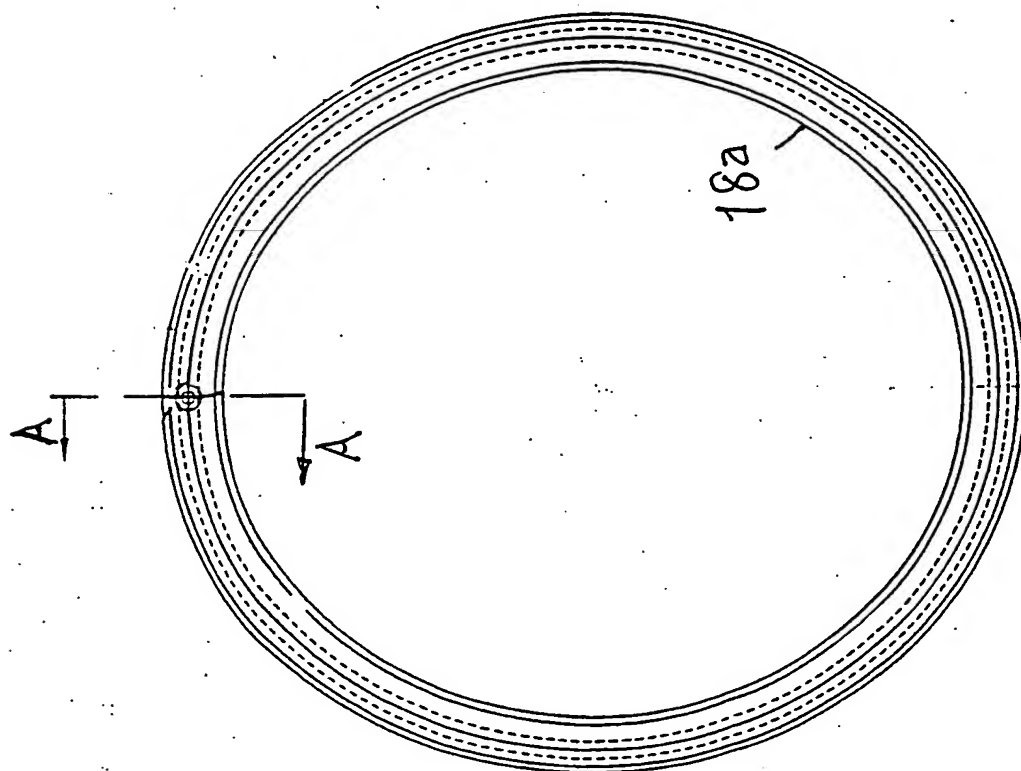


FIG. 8

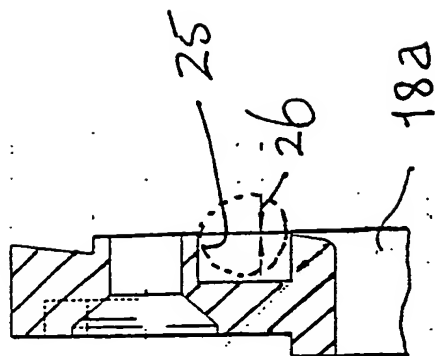


FIG. 8A

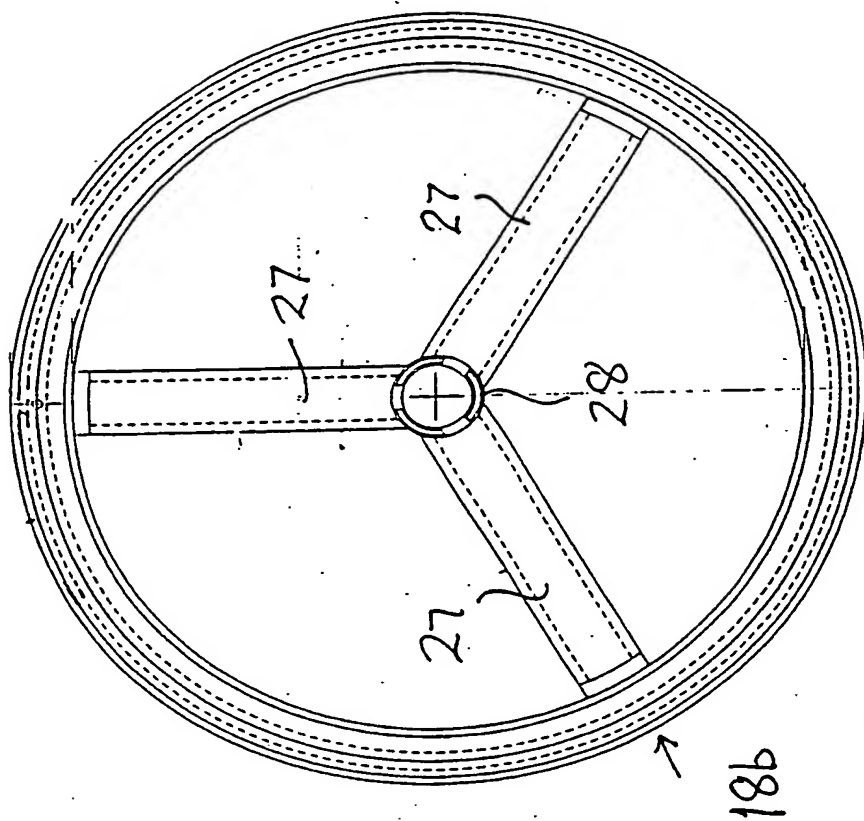


FIG. 9

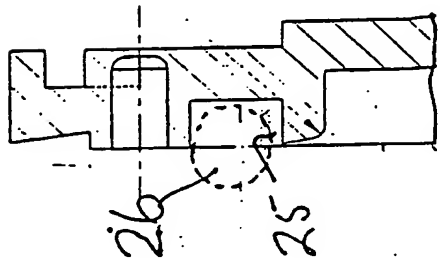


FIG. 9A

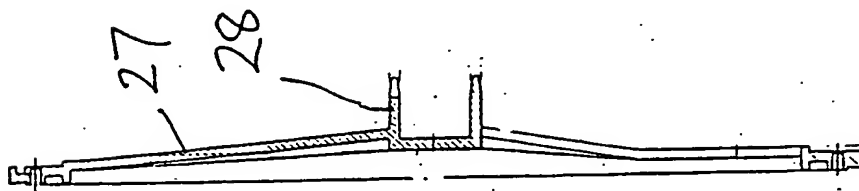


FIG. 9B

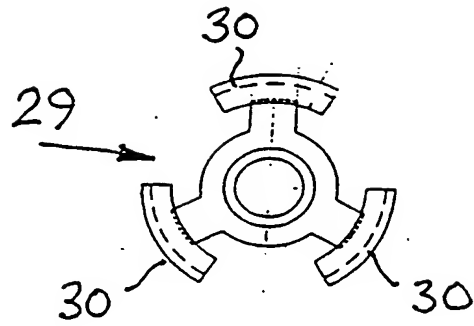


FIG. 10

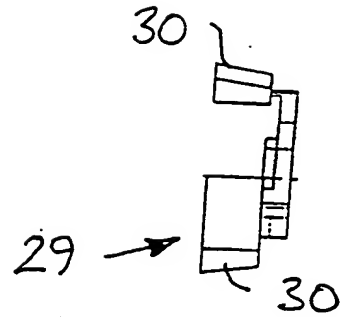


FIG. 10A

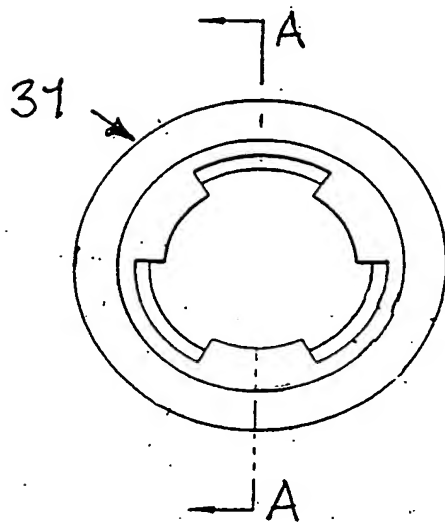


FIG. 11

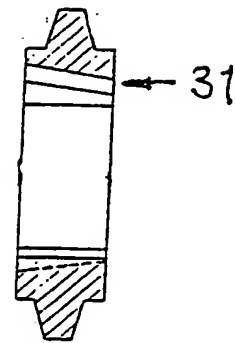


FIG. 11A

## INTERNATIONAL SEARCH REPORT

Intern: J  
Application No  
PCT/GB/00214A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 G02B26/08

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A,3 610 738 (BOCHMANN CARL E) 5 October 1971 see abstract; claims 1,4-6; figures 1-4 ---	1,3,6
A	US,A,3 623 793 (MERTEN BARRON C ET AL) 30 November 1971 see abstract; claim 1; figures 1-3 ---	1,6
A	GB,A,400 445 (PAUL WURZBURGER) 16 November 1933 see claims 1,2,11; figure 15 see page 2, line 119 - line 129 -----	1,3

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